

Charge Ratio Problem

Framework of the problem

The muon charge ratio is affected by some systematic error due to

- **Either** Deficiencies in the magnetic Field Maps
- **OR** Deficiencies in the geometry/alignment files
- **OR** Coding errors
- (or more than one of these)

Working Backwards:

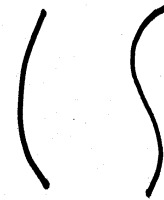
How big a change in field &/or geometry is required? We have two kinds of tracks:

1. Infinite momentum straight tracks
2. Finite momentum, curved tracks (C or S shaped)

Straight tracks



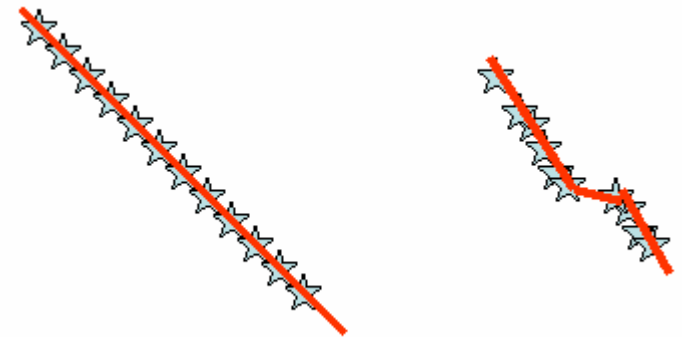
Curved tracks



Oppositely curved tracks



- It seems relatively easy to imagine a number of geometrical errors that turn a “straight” track into an S shaped track. And the errors don’t have to be large. But how large matters?



Theorem

- Errors in the field* CAN'T matter for the charge ratio integrated over momentum

Incomplete proof:

1. For curved tracks, a wrong field might affect the momentum, but never the charge.
 2. For straight tracks, the field map is irrelevant
- * Without additional source terms that change the direction of the field 180°.

Straight tracks



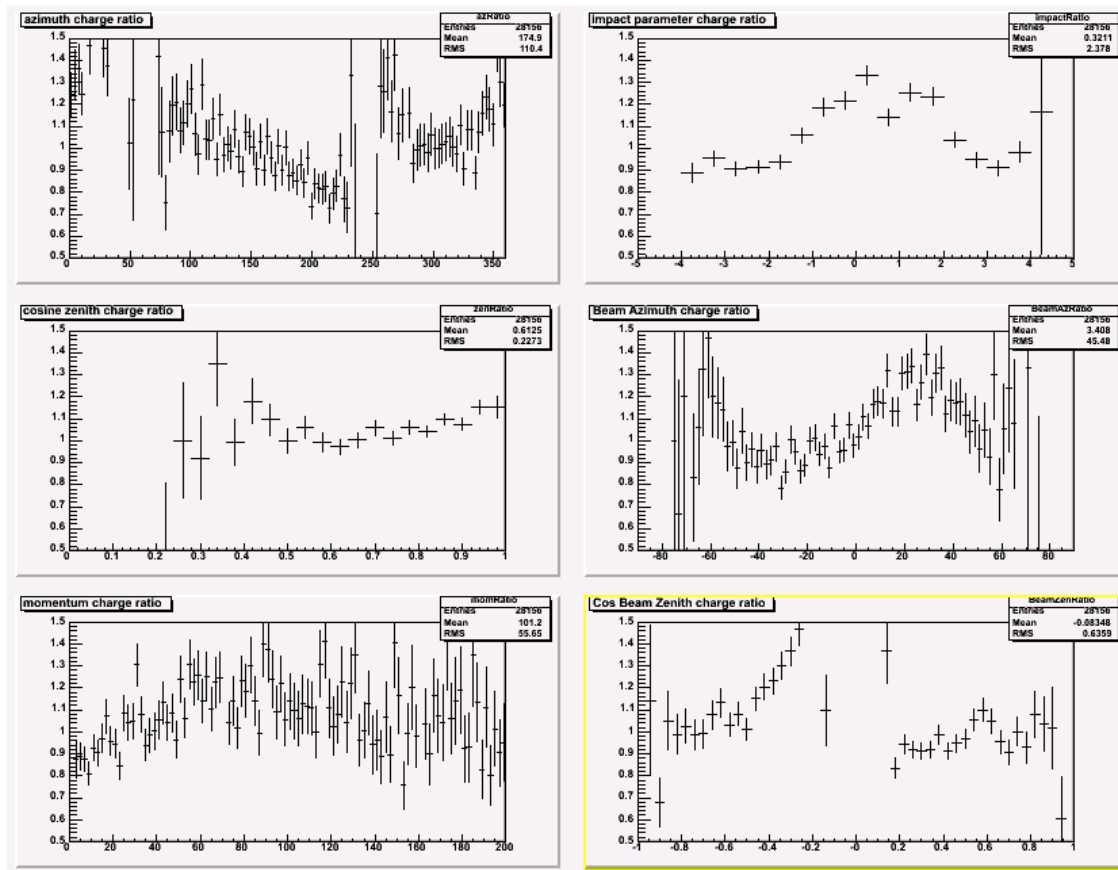
Curved tracks



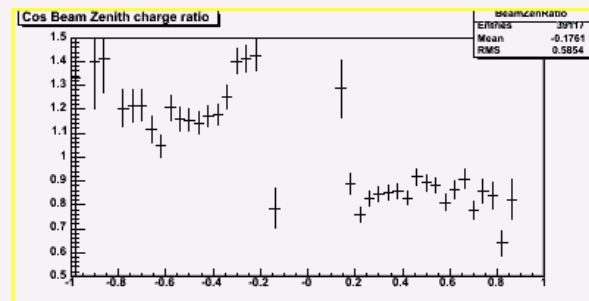
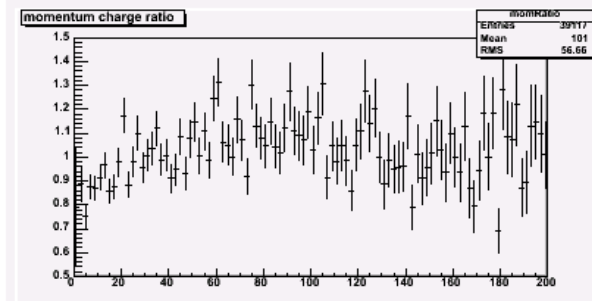
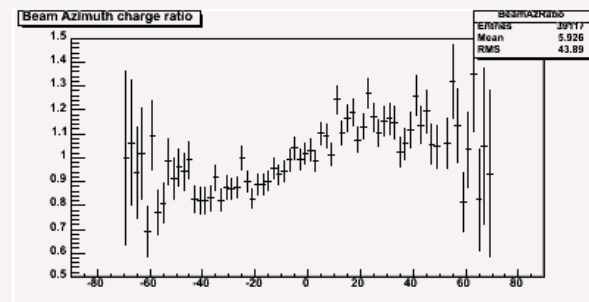
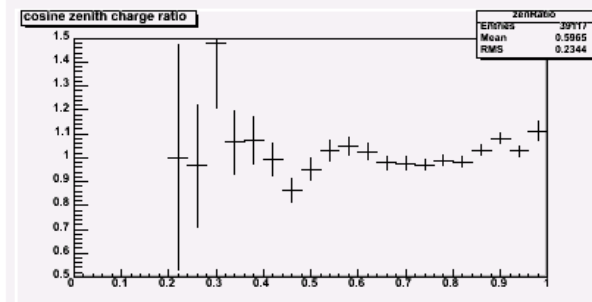
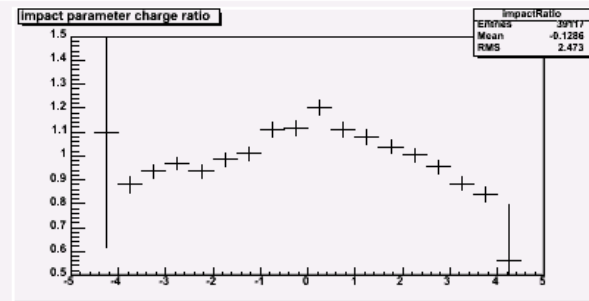
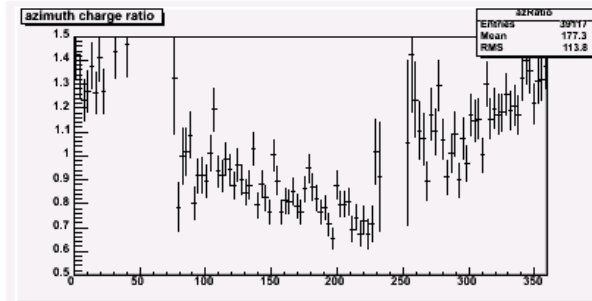
Oppositely curved tracks



SM1



SM2



Geometrical Issues we've been thinking about:

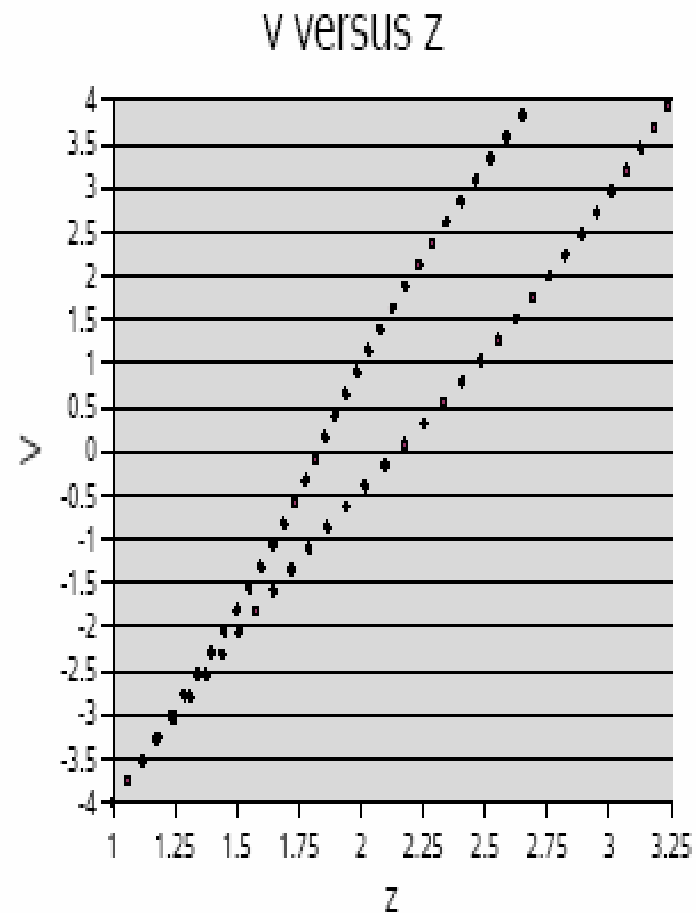
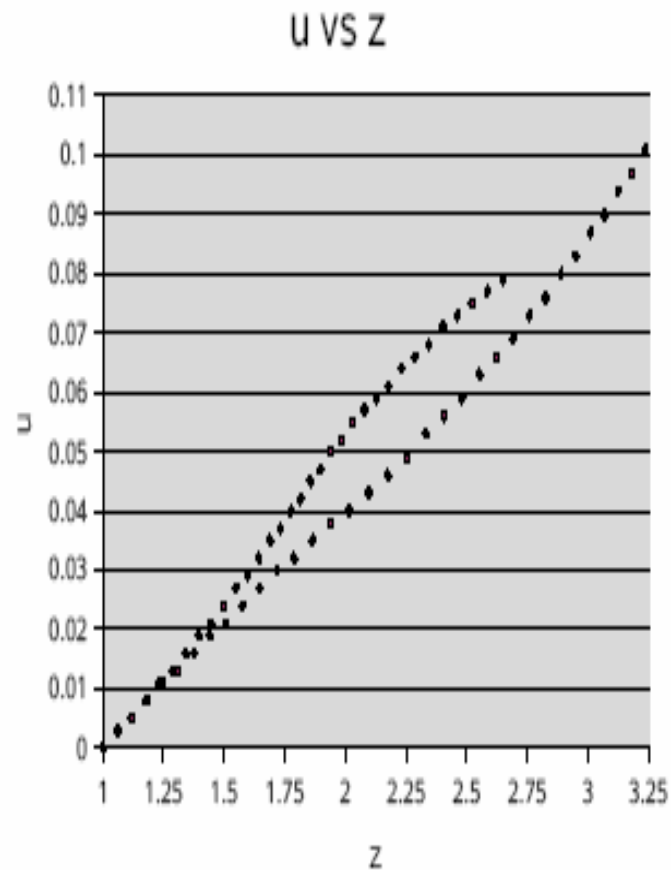
- Collars
- Sagging of the rails between supports
- X-hook at plane 200/banana shape
- Use/misuse of mapper data; strip width and gap width
- Bad channels from mapper
- Possible twist because steel ears come from separate laminations/potato chip effect
- Z issues

Calculations from Tom Fields

- For a 10 GeV track perpendicular to B,
radius of curvature $\rho = 3.34 p/B = 47.7 \text{ m}$
- For 8 m s shaped track, sagitta $s=c^2/8\rho = 4.2 \text{ cm}$
- B is \perp for impact parameter 0

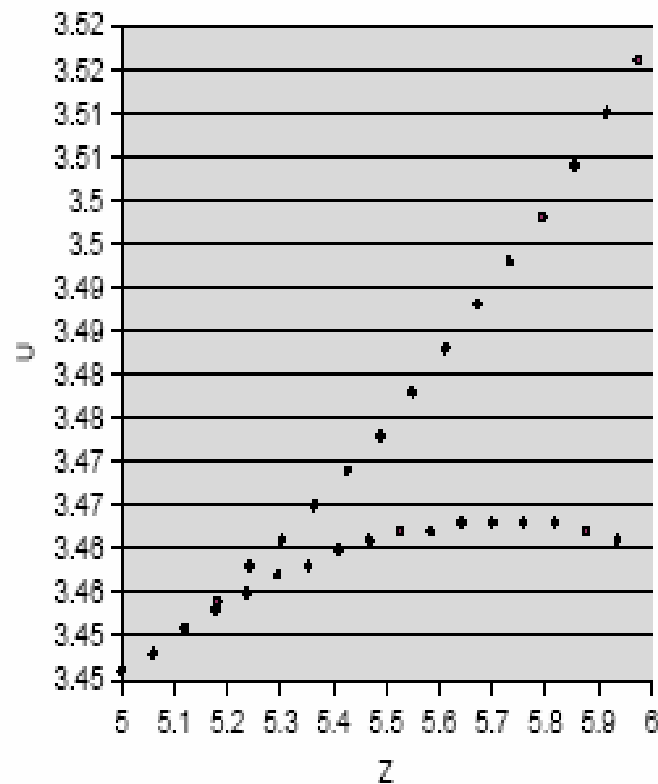
Impact Parameter	Track length	Measured sagitta	Predicted sagitta
0	8 m	3 cm	4 cm
3.48 m	4 m	0.3 cm !!!	0.5 cm

10 Gev, 8 m tracks in vz plane, impact parameter 0

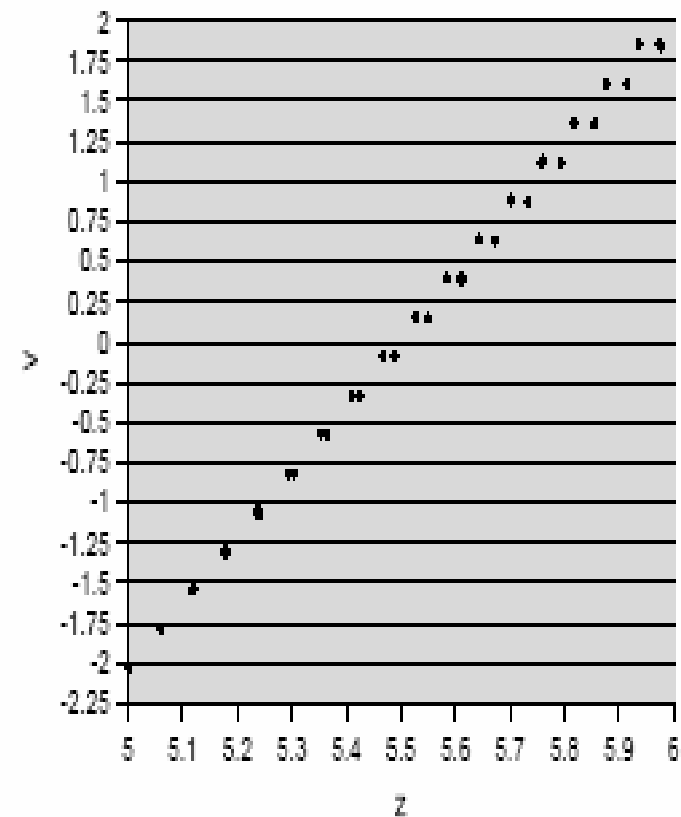


10 Gev, 8 m tracks in vz plane, impact parameter 3.5

u versus z



v versus z



Conclusion

- The sagitta is comparable to our resolution for a 10 GeV track with large impact parameter
- The sagitta is smaller than 3 mm for high momentum tracks!

Another point about u and z

- For an 8 m cosmic μ track with 20 planes,
❖ $\Delta u \sim 8 \text{ m}$, $\Delta z \sim 2 \text{ m}$
- Therefore, any mispositioning of a scintillator plane in z causes 4 times the u error than mispositioning in u

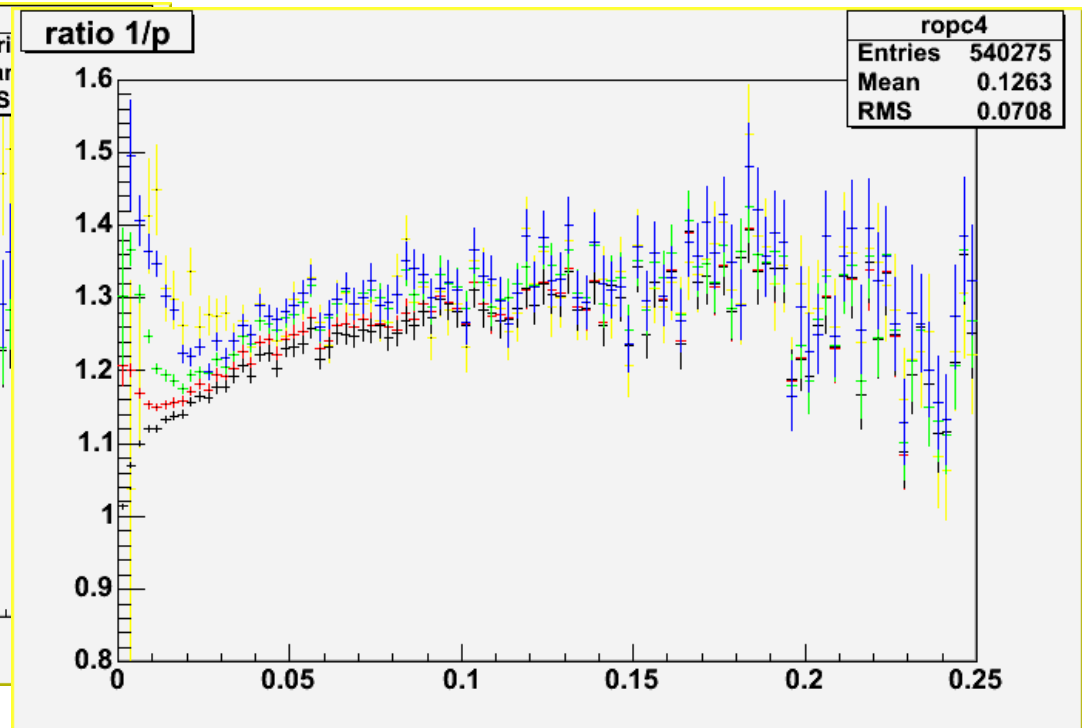
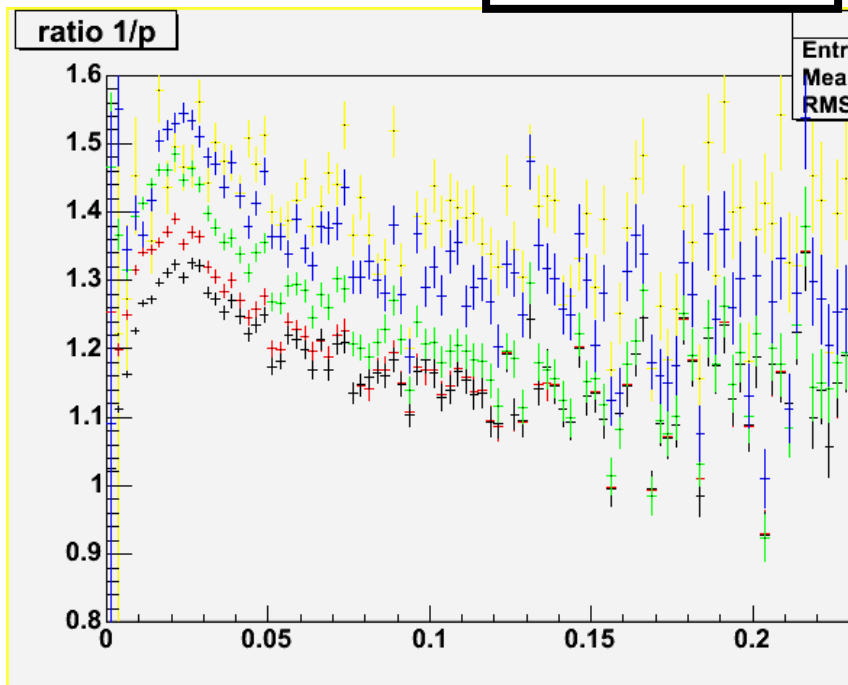
- mm scale misalignments can matter
- We need to be even more quantitative about this

1/p with 5 Alec cuts

- Black 0, Red 0.6, Green 1.2, Blue 2.5, Yellow 5

Forward

Reverse



Summed ???

